

**PATENT APPLICATION**

**SERVER-CENTRIC SEARCH FUNCTION IN AN INTERACTIVE  
PROGRAM GUIDE**

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## **SERVER-CENTRIC SEARCH FUNCTION IN AN INTERACTIVE PROGRAM GUIDE**

### **CROSS-REFERENCES TO RELATED APPLICATIONS**

5           This application claims the benefit of U.S. provisional Application Serial No. 60/205,939, entitled "SERVER-CENTRIC SEARCH FUNCTION IN AN INTERACTIVE PROGRAM GUIDE," filed May 18, 2000, which is incorporated herein by reference in its entirety for all purposes.

10           This application is also a continuation-in-part of the following U.S. patent applications, all of which are assigned to the assignee of the present invention, and incorporated herein by reference in their entirety for all purposes:

            Serial No. 09/605,522, entitled "SERVER-CENTRIC CUSTOMIZED INTERACTIVE PROGRAM GUIDE IN AN INTERACTIVE TELEVISION ENVIRONMENT," filed June 27, 2000;

15           Serial No. 09/585,263, entitled "CHANNEL INFORMATION WINDOW VIA SERVER-CENTRIC INTERACTIVE USER INTERFACE," filed June 2, 2000;

            Serial No. 09/542,433, entitled "IMPULSE PURCHASING VIA SERVER-CENTRIC INTERACTIVE UI," filed April 4, 2000;

            Serial No. 09/359,560, entitled "INTERACTIVE UI," filed July 22, 1999;

20           Serial No. 09/359,559, entitled "SYSTEM FOR GENERATING, DISTRIBUTING AND RECEIVING AN INTERACTIVE USER INTERFACE," filed July 22, 1999; and

25           Serial No. 09/583,388, entitled "ENCODING OPTIMIZATION TECHNIQUES FOR ENCODING PROGRAM GRID SECTION OF SERVER-CENTRIC IPG," filed May 30, 2000.

### **BACKGROUND OF THE INVENTION**

30           The invention relates to communications systems in general. More specifically, the invention relates to a server-centric search function in an interactive program guide.

            Over the past few years, the television industry has seen a transformation in a variety of techniques by which its programming is distributed to consumers. Cable television systems are doubling or even tripling system bandwidth with the migration to

hybrid fiber coax (HFC) cable plant. Customers unwilling to subscribe to local cable systems have switched in high numbers to direct broadcast satellite (DBS) systems. And, a variety of other approaches have been attempted focusing primarily on high bandwidth digital technologies, intelligent two way set top terminals, or other methods of trying to offer service differentiated from standard cable and over the air broadcast systems.

With this increase in bandwidth, the number of programming choices has also increased. Leveraging off the availability of more intelligent set top terminals, several companies such as Starsight Telecast Inc. and TV Guide, Inc. have developed elaborate systems for providing an interactive listing of a vast array of channel offerings, expanded textual information about individual programs, and the ability to look forward to plan television viewing as much as several weeks in advance.

With this increase in the number of programming, it is oftentimes cumbersome for a viewer to find a desired program in a guide considering, for example, two weeks of programming with 200 channels. In order to provide ease of viewing, some of the existing program guides offer customization feature such as pop-up guides or favorites selection so that program guides can be viewed or scanned through only the selected favorite list of channels.

However, in order to provide the viewer with quick access to programming and to help the viewer to more easily locate a program in an unknown channel at an unknown time period, more comprehensive features are highly desirable.

## SUMMARY OF THE INVENTION

The invention provides techniques to quickly and efficiently search a program guide database for desired programming. Aspects of the invention provide an interactive user interface, search process, and an information delivery system that implement and/or support the search and related features described herein.

An embodiment of the invention provides a method for searching a program guide database. In accordance with the method, one or more search criteria (e.g., keywords) are initially received and a request for a search is then sent, along with the search criteria, to a head end of an information distribution system. In response, one or more search results are received from the head end. In this server-centric embodiment, the program guide database is searched at the head end.

The search results can be displayed on one search result IPG page (or more, if necessary) or displayed one at a time on the respective IPG page that includes the

search result. The search results can be provided in a particular order, e.g., based on their scheduled show times. Upon receiving an indication that a particular search result has been selected, one or more streams associated with the selected search result can be retrieved and decoded to recover the selected program, which can then be displayed.

5           The search results can be provided from the head end as video slices generated via slice-based encoding or as data that is sent via an in-band channel or an out-of-band channel.

          The invention further provides IPG page, head end, and set top terminal (STT) that implement and/or support the search features of the invention.

10          The foregoing, together with other aspects of this invention, will become more apparent when referring to the following specification, claims, and accompanying drawings.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

15          The teachings of the present invention can be readily understood by considering the following detailed description in conjunction with the accompanying drawings.

          FIG. 1 depicts a block diagram of an illustrative interactive information distribution system that can benefit from the interactive user interface of the present invention;

20           FIG. 2 depicts a block diagram of subscriber equipment suitable for use in an interactive information distribution system;

          FIGS. 3A-3C depict a first embodiment of an interactive user interface;

          FIG. 4 depicts the first embodiment of the interactive user interface while emphasizing a new time slot;

25           FIGS. 5A-5C depicts a flow diagram of a process for moving from one object to another in the first embodiment of the interactive user interface;

          FIGS. 6A-6C depict a second embodiment of an interactive user interface;

          FIGS. 7A-7B depict a flow diagram of a user interaction routine;

30           FIG. 8 is a third embodiment of an interactive user interface;

          FIG. 9 depicts a first example of a layout for an IPG page;

          FIG. 10 depicts a second example of a layout of an IPG page;

          FIG. 11 is a table of functional descriptions of the keys on an input device used to control the user interface;

FIGS. 12A-B depict a fourth embodiment of a server-centric interactive user interface;

FIG. 13 depicts a server-centric system architecture for managing delivery of an interactive user interface;

5           FIG. 14 depicts a process within the system architecture that enables impulse pay-per-view purchasing via a server-centric interactive user interface;

FIG. 15 depicts a process within the system architecture that enables premium service subscriptions via a server-centric interactive user interface;

10           FIG. 16 depicts a process within the system architecture that enables impulse purchasing from advertisements via a server-centric interactive user interface;

FIG. 17 depicts schematically a spotlight or channel information window overlaying a broadcast video display in accordance with an embodiment of the present invention;

15           FIG. 18 depicts an example layout for the spotlight or channel information window in accordance with an embodiment of the present invention;

FIG. 19 depicts an illustration that includes common portions of the channel information window in accordance with an embodiment of the present invention;

FIG. 20 is a simplified flow diagram of a specific embodiment of a process to provide custom-IPG;

20           FIG. 21 is a flow diagram of a specific embodiment of a process for creating or modifying a custom-IPG;

FIG. 22 is a design of an IPG page that supports a search of a program guide database;

25           FIGS. 23A and 23B are diagrams that graphically illustrate the basic functionality of the search window object;

FIG. 24 is a diagram of a matrix representative of a program guide database;

FIG. 25 is a diagram that illustrates the search results for a particular keyword;

30           FIG. 26 depicts a design of an IPG page used to present the search results;

FIG. 27 is a diagram that illustrates the selection of a particular search result;

FIG. 28 is a diagram that illustrates one way to activate the search window on the IPG page;

FIG. 29 is a block diagram of an information distribution system that can be used to provide interactive program guide and to implement search functionality; and

FIG. 30 is a block diagram of a set top terminal (STT) suitable for producing an IPG page and supporting the search functionality.

5 To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures.

### DESCRIPTION OF THE SPECIFIC EMBODIMENTS

This invention is a unique user interface that is illustratively embodied in  
10 an interactive program guide that enables a user to interactively review, preview and select programming for a television system.

FIG. 1 illustrates a high-level block diagram of an information distribution system 100 that generates an interactive user interface in accordance with the present invention. The system 100 comprises a head end 102, a distribution network 104, and a  
15 user terminal 106 (commonly referred to as a set top terminal (STT) or set top box, although the terminal may be embedded into a user's television or other video display equipment). For simplicity, the diagram shows a single head-end 102 and a single STT 106, while it is possible to combine multiple head-end systems to provide a desired functionality for the overall system. In a practical application, there are multiple STTs  
20 106 coupled to the network 104 to enable a plurality of users to receive information from the head end 102.

The distribution network 104 is generally a high bandwidth, full duplex communications network, such as a hybrid fiber-coax network. However, the network 104 may comprise multiple simplex communications channels where together the simplex  
25 channels provide bi-directional communications between the head end and the STT, e.g., a forward channel could carry information from the head end to the STT through a cable system, while a back channel could carry information from the STT to the head end via a telephone system.

The head-end 102, which carries the most user interface-related processing  
30 power and storage capability, comprises a user interface graphics generation/storage unit 108, video source 110, compositor 112, encoding unit 114, multiplexer 116, video modulator 118, a video session manager (VSM) 120 or multiple VSM's depending on the viewer/subscriber load, and a video server 122.

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The VSM 120 performs the command and control functionality and operates as a bridge between the user interface graphics generation/storage unit 108 and the STTs (one of which is depicted as STT 106), being responsible from the establishment and maintenance of the head end-to-STT communication. Specifically, the

5 VSM controls user interface transmission to the STT and controls the response of the system to user requests that are made through the user interface

As shall be discussed in detail below, the user interface comprises both graphical information and video information under the control of the VSM 120. The video information for the user interface is produced by the video source 110 (or sources).

10 The graphical information for the user interface is produced in the user interface graphics generation/storage unit 108. The unit 108 comprises a graphics storage unit 124, a graphics server 126 and a graphics formatter 128. The graphics server 126 recalls the graphics information from the storage unit 124 and has the recalled information formatted in the graphics formatter 128 such that the graphics are in an appropriate format for use in

15 a user interface. The server 126 sends a bitmap containing the graphical information for a user interface to the compositor 112.

The compositor combines the graphics with the video to produce a composite video frame sequence. The frame sequence is then encoded within the encoding unit 114. The encoding unit 114 comprises a plurality of real-time MPEG

20 encoders 1301, 1302, ... 130n (where n is an integer). The encoding unit 114 also comprises an audio encoder 132 that encodes the audio information associated with the video source signal.

The compositor 112 produces a plurality of frame sequences containing graphics and video. For example, to produce interrelated user interfaces, the video is the

25 same in each sequence, but the graphics are different. Each of these sequences is encoded using, for example, a real-time encoder that produces an MPEG compliant bitstream. Each of the bitstreams is coupled to the multiplexer 116 to form one or more transport streams, for example, MPEG compliant transport streams. Each of the encoded user interfaces are identified in the transport streams using a unique identifier, e.g., a program

30 identifier (PID) code. As such, the STT 106 can select a particular user interface for display by selecting the identifier, e.g., selecting a PID. Once encoded and multiplexed, the transport stream or streams are then coupled to the digital video modulator 118 (e.g., a quadrature amplitude modulation (QAM) modulator) for transmission through the distribution network 104 to the STT 106.

As shall be described in detail below, the user interface that is transmitted as a digital video bitstream can be used to control and request video and other information from the information server 122. The information server 122 interacts with the VSM 120 to produce requested information for transmission to a particular STT 106, to all the STTs or a particular subset of STTs.

FIG. 2 depicts a block diagram of the STT 106 suitable for use in producing a display of a user interface in accordance with the present invention. The STT 106 comprises a tuner 210, a demodulator 220, a transport demultiplexer 230, an audio decoder 240, a video decoder 250, an on-screen display processor (OSD) 260, a frame store memory 262, a video compositor 290 and a controller 270. User interaction is provided via a remote control unit 280. Tuner 210 receives, e.g., a radio frequency (RF) signal comprising, for example, a plurality of quadrature amplitude modulated (QAM) information signals from a downstream (forward) channel. Tuner 210, in response to a control signal TUNE, tunes a particular one of the QAM information signals to produce an intermediate frequency (IF) information signal. Demodulator 220 receives and demodulates the intermediate frequency QAM information signal to produce an information stream, illustratively an MPEG transport stream. The MPEG transport stream is coupled to a transport stream demultiplexer 230.

Transport stream demultiplexer 230, in response to a control signal TD produced by controller 270, demultiplexes (i.e., extracts) an audio information stream A and a video information stream V. The audio information stream A is coupled to audio decoder 240, which decodes the audio information stream and presents the decoded audio information stream to an audio processor (not shown) for subsequent presentation. The video stream V is coupled to the video decoder 250, which decodes the compressed video stream V to produce an uncompressed video stream VD that is coupled to the video compositor 290. OSD 260, in response to a control signal OSD produced by controller 270, produces a graphical overlay signal VOSD that is coupled to the video compositor 290.

The video compositor 290 merges the graphical overlay signal VOSD and the uncompressed video stream VD to produce a modified video stream (i.e., the underlying video images with the graphical overlay) that is coupled to the frame store unit 262. The frame store unit 262 stores the modified video stream on a frame-by-frame basis according to the frame rate of the video stream. Frame store unit 262 provides the stored video frames to a video processor (not shown) for subsequent processing and



presentation on a display device. The frame store unit 262, in response to a control signal F produce by the controller 270, "freezes" in memory (i.e., does not update) a presently stored video frame such that the video information provided to the video process results in a still image. This is useful when, e.g., a user interface utilizes scrolling information, a  
5 telephone number or address is briefly displayed or a user simply wants to view a presently displayed frame for a longer period of time.

Controller 270 comprises a microprocessor 272, an input/output module 274, a memory 276, an infrared (IR) receiver 275 and support circuitry 278. The microprocessor 272 cooperates with conventional support circuitry 278 such as power  
10 supplies, clock circuits, cache memory and the like as well as circuits that assist in executing the software routines that are stored in memory 276. The controller 270 also contains input/output circuitry 274 that forms an interface between the controller 270 and the tuner 210, the transport demultiplexer 230, the onscreen display unit 260, the back channel modulator 295, and the remote control unit 280. Although the controller 270 is  
15 depicted as a general-purpose computer that is programmed to perform specific interactive program guide control function in accordance with the present invention, the invention can be implemented in hardware as an application specific integrated circuit (ASIC). As such, the process steps described herein are intended to be broadly interpreted as being equivalently performed by software, hardware, or a combination  
20 thereof.

In the exemplary embodiment of FIG. 2, the remote control unit 280 comprises an 8-position joystick, a numeric pad, a "Select" key, a "Freeze" key and a "Return" key. User manipulations of the joystick or keys of the remote control device are transmitted to a controller via an infrared (IR) link. The controller 270 is responsive to  
25 such user manipulations and executes appropriate user interaction routines 300, uses particular dynamic overlays that are available in a dynamic overlay storage 276-2 and uses particular static overlays form a static overlay storage 276-1.

FIGS. 3A-3C depict an illustrative embodiment of a user interface that contains program guide information, i.e., the interface forms an interactive program guide  
30 for television systems. This program guide is created entirely in the head end of the information distribution system of FIG. 1 and transmitted to the user's STT for decoding and display. An OSD graphics layer is either stored in the STT or transmitted with the user interface to facilitate a mask and reveal function that provides a technique to

highlight, mask, or otherwise identify objects (graphical icons and/or text) within the user interface.

The IPG display 300A of FIG. 3A comprises a first 305A, second 305B and third 305C time slot object, a plurality of channel content objects 310-1 through 310-8, a pair of channel indicator icons 341A, 341B, a video barker 320 (and associated audio barker), a cable system or provider logo 315, a program description region 350, a day of the week identification object 331, a time of day object 339, a next time slot icon 334, a temporal increment/decrement object 332, a "Favorites" filter icon 335, a "Movies" filter object 336, a "Kids" (i.e., juvenile) programming filter icon 337, a "Sports" programming filter object 338 and a VOD programming icon 333. It should be noted that the day of the week object 331 and next time slot icon 334 may comprise independent objects (as depicted in FIG. 3A) or may be considered together as parts of a combined object.

Additionally, to better understand the invention, FIGS. 3A-3C depict respective display screens of the interactive program guide (IPG) of the guide of FIG. 3A with various objects (icons and/or text) emphasized.

The interactive program guide display 300A comprises a "video layer" and a "graphics layer". In this context, the "video layer" comprises the imagery from the decoded digital video bitstream containing the video and graphical information of the user interface. As described above with respect to FIG. 1, video information, representative of each of the objects (icons and text), is generated at the head end of the system, and transmitted as part of a video stream. Thus, the actual display parameters (i.e., the size, shape, color, position and other visual parameters) associated with each object are entirely controlled at the head end.

The modifiable, via viewer interaction, objects (icons and text) are selected by, for example, a remote control device associated with the STT. Selecting the screen objects causes a locally stored and/or locally generated graphical overlay to identify the selected objects on the screen by associating each manipulable object or element with a corresponding graphical overlay element (e.g., an x-y coordinate box or other element). An overlay element is selectively emphasized or de-emphasized (e.g., selectively shading, highlighting coloring, and the like) via manipulation of the remote control unit.

The IPG display 300A of FIG. 3A is logically divided into two operational regions; a guide region (the graphical region) 302 and an image region (the video region) 304. The guide region 302 comprises the time slot objects 305, channel content objects 310-1 through 310-8 and channel indicator icons 341A, 341B. The image region 304

comprises the remaining objects that are delineated above. When a user or viewer is interacting with the program guide of the present invention, only one of these two regions will be active at any one time. Some keys or controls utilized by a viewer to control the IPG will operate differently, depending upon which region is active. The operational differences between the two regions will be described in more detail below.

Referring to the guide region 302 of FIG. 3A, it can be seen that the first time slot 305A is emphasized by a time slot highlighting object 305H. The slot 305A is emphasized with respect to the other time slots 305B and 305C, which can be said to be de-emphasized. The slot 305A can be emphasized by highlighting the slot using a colored highlighting overlay graphic 305H, or the highlighting graphic may provide a 0% opacity window through which the slot text 305A can be seen and the others slots may be overlaid with a graphic having an opacity that is more than 0%, e.g., 25, 50 or 75 percent opacity. The level of opacity is selected to facilitate clear emphasis of the selected time slot by muting the intensity of the un-selected slots. Similarly, it can be seen that each respective first title object 311A of each of the plurality of channel content objects 310-1 through 310-8 is also emphasized or highlighted by a title highlighting object 311H. Time slot emphasis is coordinated with title slot emphasis. That is, if the first time slot object 305A is emphasized or highlighted, then the first title object 311A of each of the plurality of channel content objects 310-1 through 310-8 is also emphasized or highlighted. Similarly, if the second time slot object 305B is emphasized or highlighted as in FIG. 3B, then the second title object 311B of each of the plurality of channel content objects 310-1 through 310-8 is also emphasized or highlighted. Lastly, if the third time slot 305C is emphasized as shown in FIG 3C, then the third title objects 311C are emphasized or highlighted. This coordinated highlighting or emphasizing of time slot 305 and title 311 objects assists the viewer in determining which titles within the respective channel content objects 310-1 through 310-8 are associated with which time slot.

In another embodiment of the invention, the coordinated emphasis or highlighting of time slot and title objects is accomplished by using the graphics layer to adjust a color, brightness or other attributes of an object, or display area surrounding the object. For example, an x-y coordinate grid (a rectangular cell) or other shape surrounding an object to be highlighted or emphasized may be changed in color or brightness level such that the surrounded or proximate object is emphasized. Similarly, an x-y coordinate grid or other shape surrounding an object to be non-highlighted or de-

emphasized may be changed in color or brightness level such that the surrounded or proximate object is de-emphasized.

The program description region 350 of the image region 304 is used to display a description of a presently indicated (emphasized) title. The description  
5 comprises, illustratively, one or more of a brief textual description of the title, title start and end times, title run time, title ratings (e.g., MPAA or other ratings), title reviews (e.g., "thumbs-up" or "thumbs-down" or other qualitative indicia), ranking of title in comparison to other titles (e.g., popularity, aggregated positive or negative viewer feedback) and the like.

10 The pair of channel indicator icons 341A, 341B (or a single channel indicator icons 341A or 341B) is used to indicate which of the plurality of channel content objects 310-1 through 310-8 includes a highlighted or emphasized title object 311 having associated with it title description within the program description icon 350. That is, the channel indicator icons 341A, 341B provide a visual indication of a presently  
15 indicated channel to the viewer.

It is important to note that the video barker 320 of FIG. 3A is, itself, an object that may be selected in some embodiments of the invention. Specifically, in such an embodiment where the video barker 320 is used to present a movie trailer, selection of the video barker object 320 by the user implies a desire to view that movie in, e.g., a  
20 video-on-demand context. Thus, in an embodiment of the invention where the video barker comprises an active or selectable object, selection of the video barker brings the user to a video-on-demand interaction screen where the user is provided the opportunity to purchase the movie presented in the video barker. Similarly, where the video barker is used to present merchandise or other products and/or services for sale, selection of the  
25 video barker results in the user being brought to an interaction screen suitable for fulfilling a user's desire to purchase or shop for such goods and/or services (e.g., an advertisement from a store is associated with a virtual mall, an advertisement for a restaurant is associated with a food coupon retrieval system, either virtual or via regular mail after entering a name and address).

30 Referring to FIG. 3B the second channel 310-2, which is indicated by the channel icons 341A and 341B, includes a second title 311B that is associated with the highlighted or emphasized second time slot 305B. In one embodiment of the invention, selecting this title (i.e., pressing the "select" key when the guide region is active), which is to be presented in the future, results in the user being transferred to a preview screen

depicting a preview of the selected title. For example, in the case of the selected title being a television sitcom to be broadcast in, e.g., 20 minutes from the present time, selecting that title results in the display of a preview information screen related to the sitcom. Similarly, in the case of the selected title being a boxing match or other sporting event, usually associated with a pre-game show or pre-fight program of some sort on one or more channels, the user is displayed a screen in which he or she may select which of these pre-event programs to view. Alternatively, the viewer is displayed a screen describing the upcoming fight.

When the guide region 302 is active, user manipulations of left or right arrow keys on, e.g., a remote control device, result in a change in the highlighted or emphasized time slot; while user manipulations of up or down arrow keys result in a change in the indicated channel. In the case of a change in time slot or channel indication, contents of the title description information, which is displayed in the program description region 350, is also changed. The guide region 302 becomes inactive and the image region 304 becomes active when the user utilizes the left or right arrow keys to highlight or emphasize an object within the image region (i.e., icons 331-339).

As noted above, the video streams for the IPG display may be included as a PES within a single transport stream. Thus, a user desiring to view the next 1.5 hour time interval (e.g., 9:30 – 11:00) may activate a “scroll right” object (or move the joystick to the right when a program within program grid 302 occupies the final displayed time interval). Such activation will result in the controller of the STT noting that a new time interval is desired. The video stream corresponding to the new time interval will then be decoded and displayed. If the corresponding video stream is within the same transport stream (i.e., a new PID), then the stream will be immediately decoded and presented. If the corresponding video stream is within a different transport stream, then the different transport stream will be extracted from the broadcast stream and the appropriate video stream will be decoded and presented. If the corresponding transport stream is within a different broadcast stream, then the different broadcast stream will be tuned, the different transport stream will be extracted from the different broadcast stream and the appropriate video stream will be decoded and presented.

It is important to note that each extracted video stream is associated with a common audio stream. Thus, the video/audio barker function of the program guide is continuously provided, regardless of the selected video stream.

Similarly, a user interaction resulting in a prior time interval or a different set of channels results in the retrieval and presentation of an appropriate video stream. If the appropriate video stream is not normally part of the broadcast video streams, then a pointcast session is initiated. That is, the STT sends a request to the head end via the back channel requesting a particular stream. The head end processes the request, retrieves the appropriate stream from the information server, incorporates the stream within a transport stream as a video PID (ideally the transport stream currently being tuned/selected by the STT) and informs the STT which PID should be demultiplexed, and from which transport stream it should be demultiplexed. The STT then retrieves the appropriate video PID. In the case of the appropriate video PID being within a different transport stream, the STT must first demultiplex the different transport stream (possibly even tuning a different QAM stream within the forward channel).

Upon completion of the viewing of the appropriate stream, the STT indicates to the head end that the STT no longer needs the stream, whereupon the head end tears down the pointcast session.

FIG. 4 shows an IPG display 400 illustrating the user interface in the next time slot, which is 9:30 to 11:00 PM. The next time slot object 334 in FIG. 3A indicates 9:30 PM as each time slot in the exemplary embodiment comprise one and half hour time interval. Upon viewer selection of object 334 in FIG. 3A, the time slot in guide region changes to 9:30 PM to 11:00 PM. Therefore, the time slot objects 305A, 305B, and 305C in FIG. 4 indicate 9:30, 10:00, and 10:30 PM respectively. The time slot object also changes and indicates 11:00 PM in FIG. 4.

When the image region 304 is active, activations of up or down arrows by a user via a remote control device results in incrementing and decrementing the indicated next time slot. Upon receiving a select command, the video PID including the channel information for the time indicated by the selected next time slot object 334 is retrieved. In the case of that video stream being part of a currently broadcast or currently used video stream (e.g., another user had requested this stream), the head end provides information to the set top terminal enabling the set top terminal to identify the video PID including the appropriate channel guide information. The set top terminal then retrieves the appropriate video PID. If the selected video PID is located in a different transport stream, then the audio PID is also retrieved from the new transport stream.

This process of moving from one program guide page to another is depicted in FIGS. 5A-5C. FIG. 5A depicts a flow diagram 500A illustrating contextual

changes in the IPG display screen 300A in response to horizontal increment and decrement (right/left) commands, such as right arrow and left arrow key activations from, e.g., a remote control. Each of the objects depicted in the contextual flow diagram comprises a video object having associated with it a graphical overlay providing emphasis to indicate an active (i.e., selectable) object or de-emphasis to indicate a non-active object (i.e., non-selectable).

The objects depicted in the contextual flow diagram 500A of FIG. 5A comprise a subset of the objects shown in the IPG display screen 300 of FIG. 3A. Specifically, the objects depicted in the contextual flow diagram 500A of FIG. 5A comprise, in the order of emphasis in response to a right arrow or horizontal increment: the first 305A, second 305B and third 305C time slot objects of the IPG display screen guide region. These objects are followed by the following IPG display screen image region objects: day of week identification object 331, next time slot object 334, "favorites" filter object 335, "movies" filter object 336, a "kids" filter object 337 "sports" filter object 338 and VOD user interface object 338. It should be noted that while the objects depicted in the contextual flow diagram 500A comprise objects depicted in the IPG display screen 300, other IPG display screens may be adapted accordingly.

For purposes of this discussion it is assumed that the first object to be highlighted or emphasized is the first time slot object 305A. Referring to FIG. 5A, in response to a first right arrow or horizontal increment 501, the first time slot object 305A is de-emphasized and the second time slot object 305B is emphasized; in response to a second right arrow or horizontal increment 502, the second time slot object 305B is de-emphasized and the third time slot object 305C is emphasized; in response to a third right arrow or horizontal increment 503, the third time slot object 305C is de-emphasized and the day of week identification object 331 is emphasized, and so on for the (504) next time slot object 334; (505) "favorites" object 335; (506) "movies" selection object 336; (507) "kids" selection object 337; (508) "sports" selection object 338; (509) "VOD" selection object 436 and, finally, is returned to the (610) first time slot object 305A.

The graphical representation of FIG. 3A is divided into guide region objects (the three timeslots 305A-305C) and image region objects (the remaining objects 331-338). The functionality of vertical increment (up arrow), vertical decrement (down arrow), page up, and page down depends on which region is activated. The differences between guide region and image region key functionality will be discussed in more detail below with respect to Figs. 5B and 5C.

When the guide region is active (any of objects 305A-305C emphasized), the up and down arrow keys are used to scroll through the various portions of the guide region. That is, the content object number (310-1 through 310-8) is changed by one (i.e., incremented or decremented) in response to up arrow or down arrow activation.

- 5 Similarly, the displayed video stream is changed (via selecting the next or prior video PID) in response to page up or page down key activation. Thus, active guide region functionality provides for navigation of the various video streams providing broadcast IPG screens to a user.

- When the image region is active (any of objects 331-338 emphasized), the  
10 up and down arrow keys are used to change the next time slot object 334, while the page up and page down keys are used to change the day of week identification object 331. Specifically in response to an up arrow key activation, the next time slot object 334 is incremented by, e.g., 1.5 hours by selecting the video PID including the guide information for the next three time slot objects of the current channels presented in the  
15 guide region. Similarly, in response to a page up key activation, the day of week identification object 331 is incremented by 1 day by selecting the video PID including the guide information for the next day of the current channels presented in the guide region.

- FIG. 5B depicts a contextual flow diagram to illustrate the changes in the IPG display screen 300A in response to vertical increment and decrement (up/down)  
20 commands received while a guide region object is highlighted or emphasized.

- The objects depicted in the contextual flow diagram 500B of FIG. 5B comprise a subset of the objects shown in the IPG display screen 300 of FIG. 3. Specifically, the objects depicted in the contextual flow diagram 500B of FIG. 5B comprise the channel content object 310-1 through 310-8 as indicated by the channel  
25 indicator objects 341A and/or 341B. In response to successive down arrow or vertical decrement key activations, the indicated channel content object traverses from 310-1 to 310-2 (520); 310-2 to 310-3 (521); 310-3 to 310-4 (522); 310-4 to 310-5 (523); 310-5 to 310-6 (524); 310-6 to 310-7 (525) and 310-7 to 310-8 (526). Similarly, activating an up arrow or vertical increment key changes the indicated channel in the reverse order.

- 30 In response to a down arrow activation while channel object 310-8 is indicated, the "next" video PID is selected for display. That is, the video PID containing the next eight channels to be displayed for the currently viewed time slot is selected. If the last eight channels are presently being displayed, then the video PID associated with the first eight channels is selected (i.e., channel "roll-over"). In the case of the "next"



video PID being part of a different transport stream, the related transport stream is retrieved and the appropriate video PID and the associated audio and data PIDs are extracted.

In response to an up arrow activation while channel object 310-1 is indicated, the “prior” video PID is selected for display. That is, the video PID containing the prior eight channels to be displayed for the currently viewed time slot is selected. If the first eight channels are presently being displayed, than the video PID associated with the last eight channels is selected (i.e., channel “roll-under”). In the case of the “prior” video PID being part of a different transport stream, the related transport stream is retrieved and the appropriate video PID and the associated audio and data PIDs are extracted.

FIG. 5C depicts a contextual flow diagram to illustrate the changes in the IPG display screen 300A in response to vertical increment and decrement (up/down) commands received while an image region object is highlighted or emphasized.

The object depicted in the contextual flow diagram 500C of FIG. 5C comprises the next time slot object 334 shown in the IPG display screen 300A of FIG. 3. Specifically, when an image region object is activated, the next time slot object 334 is incremented or decremented in response to, respectively, an up arrow or vertical increment key activation and a down arrow or vertical decrement key activation. In the exemplary embodiment, the next time slot object 334 is delineated in 1.5 hour intervals (i.e., the time slot following the three time slots 305A, 305B and 305C of the guide region) for a 24 hour period.

In one embodiment of the invention, the operations described in the contextual flow diagram 5C only occur if the next time slot object 334 or a combined object comprising the day object 331 and next time slot object 334 are highlighted or emphasized. In another embodiment of the invention, the operations described in the contextual flow diagram 5C occur when any image regions object is highlighted or emphasized.

In response to successive up arrow or vertical increment key activations, the indicated next time slot object traverses from the actual (with respect to the present time) next time slot (551) to a next time slot + 3 (552) via path 5512; a next time slot + 6 (553) via path 5523; a next time slot + 9 (554) via path 5534 and so on up to a next time slot + 21 (558) via path 5578. An additional up arrow or vertical increment key activation results, in the present embodiment, in a return to the next time slot (551) via

path 5581. Similarly, activating a down arrow or vertical decrement key changes the indicated next time slot object in the reverse manner, except for one case. Specifically, in the case of activating a down arrow or vertical decrement key when the next time slot (551) is indicated, the system enters a time shift mode 556 via path 5516.

5                   FIG. 6A depicts a second embodiment of a user interface in accordance with the present invention. The first time slot 305A is emphasized and that only the first title object 311A within each of the channel content objects 310 is shown. That is, only the title object associated with the emphasized time slot is "revealed," while the title objects associated with the non-emphasized time slots are "masked." This "mask and  
10 reveal" method of presentation provides an IPG display that some viewers find more desirable than the previously described (with respect to FIGS. 3A-3C) muting or reduced opacity de-emphasis method of presentation. However, the muting or reduced opacity de-emphasis method of presentation does present more information to the viewer in each IPG display.

15                   Referring simultaneously to FIGS. 6A through 6C, FIG. 6A depicts an IPG display 600A having the first time slot 305A emphasized and each of the title objects 311A associated with the first time slot being revealed, while each of the title objects 311B, 311C associated with the non-emphasized time slots 305B and 305C are masked (hidden). In FIG. 6A, the first time slot object 305A is emphasized, and the second and  
20 third time slots 305B and 305C are de-emphasized; in FIG. 6B the second time slot object 305B is emphasized, while the first and third time slot objects 305A and 305C are de-emphasized; and in FIG. 6C the third time slot object 305C is emphasized while the first and second time slot objects 305A and 305B are de-emphasized. Note that in all cases the operation of the title description object 350 remains unchanged, as does the operation  
25 of the video barker 320 and all the other functional elements of the program guide. By using the mask and reveal technique, the irrelevant information in the IPG is effectively removed to simplify the user interface. When the user has previously defined certain programs as favorites, the subsequent selection of the "favorites" icon 335 masks all non-favorite programming. Similarly, selecting the "Sports" icon 338 masks all non-sports  
30 programming.

FIGS. 7A and 7B together form FIG. 7 and comprise a user interaction method 700 according to the invention. FIG. 7 depicts a user interaction routine 700 according to the invention. The routine 700 is entered at step 702, when the subscriber equipment is initially powered on or initialized. The routine then proceeds to step 704,

the first or default stream is tuned and demodulated. The routine 700 then proceeds to step 706, the first or default video stream and associate audio stream is demultiplexed and displayed. The routine 700 then proceeds to step 708, where an appropriate overlay is retrieved and displayed along with the displayed or presented video stream. The routine  
5 700 then proceeds to step 710, where the STT waits for user input via, e.g., remote control device 280. Upon receipt of user input, the routine proceeds to step 712 to evaluate the input. The routine 700 then proceeds to step 714, where a query is made as to whether the user interaction abstraction level is contextual, i.e., the contextual IPG changes that requires information to be sent from head end or local/contextual that carries  
10 interaction processes both locally at STT and request information from head end.

If the query at step 714 indicates that a contextual change is requested by the viewer, then the method 700 proceeds to step 716, where a query is made for the pressed key type. If a Return key is pressed, the algorithm proceeds to 718, where the system reacquires the previous context. For example, the viewer may have previously  
15 been viewing a movie preview and, at the end of the preview, the viewer has been returned to the IPG context. If the viewer then presses the Return key, he or she is returned to the previous context and the movie preview is re-displayed. At the end of the requested context presentation, the method 700 returns to step 710.

If, at step 716, the viewer presses a Select key to select a presently  
20 emphasized or highlighted object, the method 700 proceeds to step 720 where the context is identified as being changed. At step 722, the new context functions are performed. For example, the user may have highlighted and then selected the "video-on-demand" icon. Such a selection will cause the system to enter the video-on-demand (VOD) context. In this context, the STT is sent a VOD navigator in a pointcast manner to enable the user to  
25 select a movie to view. Other context changes result when the viewer selects the video barker, any of the programs in the guide region of the IPG display, and the like. Barker selection causes the system to enter a barker defined context, i.e., a movie, if the barker was displaying a movie preview; a sales page, if the barker was advertising a product; and so on. The selection of a program available for viewing in the current time frame causes  
30 the system to send the program video to the STT's either as pointcast or broadcast stream. The stream type depends upon the program selection. The selection of a program listed in an upcoming time slot results in display of a preview of the selected program.

If the query at step 714 indicates that local interactivity is requested by the user, then the method 700 proceeds to step 740, where a query is made to identify the

type of key pressed by the user. If the query at step 740 indicates that a freeze key has been pressed, then the method 700 proceeds to step 734, where the video frame presently stored in the frame store unit 262 is frozen. That is, the frame store unit 262 is not updated by subsequent video frames until such time as a freeze key or other key is pressed. The method 700 then proceeds to step 710, where the processor waits for user input.

If the query at step 714 indicates that one of an increment or decrement key has been pressed (e.g., a channel indication increment or decrement command), then the method proceeds to step 744. If the query at step 740 indicates that one of the page up or page down keys has been depressed, then the method 700 proceeds to step 742.

At step 742, a query is made to determine whether the page up key has been pressed. If this is the case, then the method 700 proceeds to step 732. Then, a query is made at step 732 to determine whether the PID being viewed is the first PID in the transport stream. If this is the case, then, depending on the organization of the video PIDs in a single or multiple transport streams, either it is tuned to the previous broadcast stream or it is wrapped around to the last video PID in the same transport stream. If the query at step 732 reveals that the PID is being viewed is not the first PID in the transport stream, then the previous video PID in the same transport stream is demultiplexed and displayed. If the query at 742 indicates that a page down key has been pressed, then the method 700 proceeds to step 726. Then, a query is made at step 726 to determine whether the PID being viewed is the last PID in the transport stream. If this is the case, then, depending on the organization of video PIDs in a single or multiple transport streams, either it is tuned to next broadcast transport stream or it is wrapped around to the first video PID in the same transport stream. If the query at step 726 reveals that the PID being viewed is not the last PID in the transport stream, then the next video PID in the same transport stream is demultiplexed and displayed.

At step 744, a query is made as to whether an increment key has been pressed. If the query at step 744 is answered affirmatively, then the method 700 proceeds to step 746. If the query at step 744 is answered negatively (i.e., a decrement key has been pressed), then the method 700 proceeds to step 748.

At step 746, a query is made as to whether the upper most channel of the program guide (i.e., channel content object 310-1) is presently indicated by channel icons 341A and 341B. If the query at step 746 is answered affirmatively, then the method 700

proceeds to step 732 and continues as described above with respect to step 732. If the query at step 746 is answered negatively, then the method 700 proceeds to step 750.

At step 750 a query is made as to whether an upper threshold level has been reached. An upper threshold level is a pre-set channel number (in the group of channels of an IPG page) at which a request for a prior channel PID should be made if such a prior channel PID is unavailable. If the query at step 750 is affirmatively answered, then the method 700 proceeds to step 754. If the query at step 750 is negatively answered, then the method 700 proceeds to step 758.

At step 754, a determination is made as to whether the prior channel group is available. An available channel group is a channel group within a video stream that is presently being broadcast or narrow cast or pointcast to one or more set top terminals. As previously noted, the set top terminal receives information associating each channel group with a particular video stream as identified by a unique PID. If the unique PID, or the stream associated with the unique PID is not being broadcast, narrow cast or pointcast, then it is appropriate at this time to request that the head end begins a pointcast session so that the prior channel group can be received by the set top terminal without undue delay (e.g., without the user experiencing latency due to the amount of time required to process and respond to a request for a video stream). If the query at step 754 is answered negatively, then the method 700 proceeds to step 756, where a request for the prior channel group is sent to the head end for processing. The method then proceeds to step 756. If the query at step 754 is answered affirmatively, then the method proceeds to 758.

At step 758, the channel indicator is moved up by one channel content object 310. That is, the channel content object immediately above the presently indicated channel content object is now indicated. The method 700 then proceeds to step 710, to wait for the next user input.

If the query at step 744 is negatively answered, then the method 700 then proceeds to 748. At step 748, a query is made as to whether the presently indicated channel is the last lower channel. That is, a query is made as to whether the presently indicated channel is channel content object 310-8 in FIG. 3A. If the query at step 748 is answered affirmatively, then the method 700 proceeds to step 726. It is important to note that if the presently indicated channel is associated with channel content object 310-8, then a decrement command, as noted above with respect to FIG. 5B and path 532 requires the selection of the next channel PID to display the upper most channel of the next

channel group (i.e., channel content object 310-1 of the next channel group). If the query at step 748 is answered negatively, then the method 700 precedes to step 760.

At step 760, a query is made as to whether a lower threshold has been reached. If the query at step 760 is answered negatively, then the method 700 proceeds to step 768. If the query at step 760 is answered affirmatively, then the method 700 proceeds to step 764.

At step 764, a determination is made if the next channel group is available. This is, similar to step 754 described above, a determination is made if a presently broadcast, narrowcast, or pointcast stream includes an IPG guide display including information related to the next channel group. If the query at step 764 is answered affirmatively, then the method 700 proceeds to step 768. If the query at step 764 is answered negatively, then the method 700 proceeds to step 766.

At step 766, a request is made by the set top terminal to the head end for the head end to send information associated with the next channel group (i.e., the guide and image portions of the IPG display including the next channel group, or alternatively, a previously stored video screen including the appropriate information). As previously noted, by requesting such information at this point the apparent latency of the system, as experienced by the user, is greatly reduced. The method 700 then proceeds to step 768.

At step 768, channel icons 341A and 341B are decremented or moved down by one channel content object 310. The method 700 then proceeds to step 710, where it waits for user input.

FIG. 11 depicts a tabular representation of the functions of various keys on an input device, such as a remote control, during guide region and image region operation. The functions of some of the depicted keys have been described above and, therefore, will not be additionally discussed. Specifically, FIG. 11 depicts the guide region and image region functionality of the increment (up arrow), decrement (down arrow) page up, page down, horizontal increment (move right), horizontal decrement (move left) select and add/remove keys. The Select key is used to select a highlighted or emphasized object to, e.g., enter a different operating mode (image region response) of tune an indicated channel (guide region response). The add/remove key is used to add a presently tuned channel to the list of favorites. If the presently tuned channel is already on the list, then the channel is removed from the list of favorites. Optionally, the viewer is queried as to whether the viewer really intends to remove the channel from the favorites list.

FIG. 8 depicts third embodiment of an interactive program guide (IPG) 800 according to the invention. Specifically, the exemplary interactive program guide screen 800 comprises a time of day/date (TOD) indicator 805, a promotional "splash" icon 810, a cable system or provider logo 815, a video barker 820 (and associated audio barker), a program time indicator 825, a channel number indicator 830, a channel identifier (text or logo) 835, a pair of channel display decrement icons 840a and 840b, a pair of channel display increment icons 845a and 845b, a temporal increment icon 848, a temporal decrement icon 847, a program grid 850 and a scrolling promotional banner 855. The interactive program guide display 800 is displayed on a television screen or other video presentation device in, e.g., the home of a subscriber to a cable television or other information distribution system utilizing the interactive electronic program guide.

FIG. 8 depicts third embodiment of a display screen of an interactive program guide (IPG) 800 that is formed in a manner similar to that described above with respect to the IPG display 300 of FIG. 3. The primary differences between the IPG displays of FIG. 8 and FIG. 3A are as follows:

1. The IPG display 300 shows only the programs at a specified time interval, such as 8:30 to 9 PM, whereas display 800 shows the complete time interval.
2. The IPG display 300 does not contain grid structure to show the program versus time interval information. It is a completely unique user interface design.
3. The IPG display 800 of FIG. 8 utilizes a program grid 850 to present programming information, whereas the IPG display 300 of FIG. 3A utilizes an enhanced "mask and reveal" technique to present more information to a viewer while reducing the amount of display clutter experienced by the viewer in navigating through the available programming choices. Only the desired programs are shown.
4. The IPG display 300 of FIG. 3A includes a program description object 350 that is used to display, illustratively, a brief textual description of a program occupying a presently indicated time slot of a presently indicated channel.

In addition to these differences, there can be found many other ones to differentiate the two user interfaces. However, the supporting system is designed to produce either of these interfaces.

Upon receiving a "Select" entry from the remote control unit, the set top terminal transmits, via a back channel or some other communications path, the information that identifies the selected object to the head end. It is important to note that, as with the mask and reveal technique, changing the emphasis of an object or element is performed entirely at a local level within the STT. That is, there is no change in the actual video information transmitted by the head end to the subscriber. Only the graphical overlay layer on the display is changed within the STT to facilitate object emphasis.

The interactive program guide display 800 (i.e., the video layer provided by the head end) depicts a program offering of 10 channels within a 1.5 hour time interval. Since there are 24 hours in a day, 16 video streams (each representing one program guide screen) are required to depict 24 hours of program offerings of 10 channels. These 16 video streams may be included within a single transport stream. Thus, a user desiring to view the next 1.5 hour time interval (e.g., 9:30 – 11:00) may activate a "Scroll Right" object (or move the joystick to the right when a program within the program grid 850 occupies the final displayed time interval). Such activation will result in the controller of the STT noting that a new time interval is desired. The digital video stream corresponding to the new time interval will then be decoded and displayed, i.e., the STT selects the bitstream within the transport stream that represents the desired program guide and decodes that bitstream. The process for selecting and decoding a bitstream is accomplished in the same manner as described above.

FIGS. 9 and 10 are graphical depictions of two different program guide layout formats. FIG. 9 depicts a program guide screen comprising a horizontally disposed guide region 910 occupying a large portion of a lower half of the IPG screen 901, and a video barker or image portion 920 occupying a portion of the top half of the screen 901. FIG. 10 depicts a program guide screen comprising a horizontally disposed guide region 1010 occupying a large portion of a lower half of the IPG screen 1002, and a video barker or image portion 1020 occupying a portion of the top half of the screen 1002.

The foregoing description details three layouts for a user interface, however, any user interface layout that can be produced in a head end as a digital video bitstream and sent to a user is considered to be within the scope of the invention. As a further example, the informational video could be a program that is being watched and the graphical imagery could be an HTML page that is associated with the program. The program video could also be contained in the IPG display such that the viewer can



continue watching a program while browsing the IPG for other program scheduling information.

FIGS. 12A-12B depict a fourth embodiment of a server-centric interactive user interface. Preferably, the present invention is used in conjunction with this  
5 embodiment of a server-centric UI. However, the present invention also has applicability beyond this particular embodiment.

The UI 1200 of FIGS. 12A-12B provides for services such as impulse purchasing and reminders. In particular, Fig. 12A shows a screen 1200 which provides for impulse purchasing of pay per view (PPV) content, and Fig. 12B shows a screen 1250  
10 which provides for a programming reminder.

The screen 1200 of Fig. 12A illustrates impulse purchasing of PPV content. A selectable PPV broadcast ["Days of Thunder (1990)"] and a corresponding beginning time of the PPV broadcast ["8:05 PM"] are displayed on the screen 1200. This PPV information is provided along with the broadcast programming data for timeslots  
15 during which the PPV broadcast occurs. For example, if the PPV broadcast is to occur from 8:05 pm to 9:25 pm, then the in order to encourage impulse purchasing of the PPV content. In the particular screen 1200 shown, the PPV information would be displayed along with programming guide data for the 8:00 pm, 8:30 pm, and 9:00 pm timeslots.

When the title of the PPV content is selected, the title is highlighted (for  
20 example, by changing color), and a description of the PPV content is provided ["Days of Thunder (1990) –You can't stop the thunder. He's a hot driver with an attitude ...."]. The description is provided in a box that goes from the left side to the right side on the bottom of the screen. In contrast, a similar description box in Fig. 6A-6C goes from only the middle to the right side on the bottom of the screen.

25 In addition, a pop-up object appears which prompts the viewer as to whether he/she wishes to purchase the PPV program. The pop-up object may lay over the video barker and may be drawn by the STT from data stored at the STT (or alternately encoded at the head end and downloaded as a video stream to the STT). By selecting the "Yes" in the pop-up object, the viewer is able to purchase the PPV program for viewing.  
30 In one embodiment, a password would need to be entered in order to authorize the purchase. Optionally, the ability to make such a purchase may be disabled during the last several minutes of the PPV program since viewers are unlikely to want to pay for viewing only the last several minutes.

The screen 1250 of Fig. 12B illustrates provision of a programming reminder. A broadcast program ("4 NBC 3rd Rock from the Sun") is shown at a particular future timeslot (8:30 PM).

When the title of the broadcast is selected, the title is highlighted (for example, by changing color), and a description of the broadcast program is provided ["Dick and Tuck-A photo of Harrison Ford ...."]. In addition, a pop-up object appears which prompts the viewer as to whether he/she wishes to set a reminder for the program. The pop-up object may lay over the video barker and may be drawn by the STT from data stored at the STT (or alternately encoded at the head end and downloaded as a video stream to the STT). By selecting "Yes" in the pop-up object, the viewer sets the reminder. Once the reminder is set, then at or slightly before the program is to begin, the STT will provide a reminder by display and/or sound.

FIG. 13 depicts a server-centric system architecture 1300 for managing delivery of an interactive user interface. A preferred embodiment of the present invention utilizes the server-centric system architecture 1300 to provide for impulse purchasing and other services. However, the present invention also has applicability in conjunction with other system architectures.

The server-centric system architecture 1300 includes a local interactive program guide (IPG) center 1302, a head end 1304, a service center 1306, and a plurality of set-top terminals (STT) 1308. In addition, the system may be integrated with a video on-demand (VOD) system 1310 and a corresponding VOD application 1338 at the STT 1308.

The local IPG center 1302 generates guide page user interface (UI) screens and periodically sends the UI screens to an IPG server 1312 at the head end 1304.

MSO/third party IPG add-on content 1314 may be provided to the IPG server 1312 from MSO equipment within the head end 1304. For example, the add-on content may include real-time advertisement video or HTML pages for electronic commerce.

The IPG server 1312 composes (C), encodes (E), processes (P), multiplexes (M), and modulates (QAM) the IPG content (guide plus add-on content) and transmits it to a combiner 1316. The combiner 1316 combines the IPG content with broadcast TV, premium content (e.g., HBO), pay-per-view (PPV), and other content from a multiple service operator (MSO) content delivery system 1318. The combined content is then broadcast to the STTs 1308 via an in-band distribution network 1320.

Upon viewer tuning of the STT 1308 to the IPG channel, an IPG application 1322 at the STT 1308 processes the IPG stream and provides the IPG via an application programming interface (API) 1324 to a "native" application 1326 running on the STT 1308. The native application 1326 decodes and presents the IPG to the viewer.

5 In one embodiment, the TV program guide for a current time period (1.5 hours) is broadcast to viewers. In addition, two weeks of look-ahead TV programming may be delivered to viewers on demand via demand-cast. Upon a view action of moving a cursor to a look-ahead time interval, the STT 1308 sends a request via a back channel to a session manager (SM) 1328 [for example, via an out-of-band channel to a reverse path demodulator (RPD), then to a network controller (NC), then to the SM 1328]. The SM 1328 then causes the IPG server 1312 to multiplex the requested IPG page into the IPG stream.

10 The SM 1328 also interacts with a subscription/billing interface 1330 in the VOD system 1310 to coordinate access to VOD services from a link in the IPG user interface (UI). The UI also provides for access to premium content and pay-per-view purchasing by interacting through a two-way interface to a MSO customer management system (CMS) 1332 and digital access controller (DAC) 1334 in the service center 1306. The DAC 1334 generates digital encryption-related keys.

15 The server-centric system architecture 1300 also includes a bandwidth manager (BWM) 1336. The BWM 1336 provides techniques for more efficient utilization of the finite bandwidth available for distribution of the interactive user interface.

FIG. 14 depicts a process within the system architecture 1300 that enables impulse pay-per-view purchasing via a server-centric interactive user interface. As shown in FIG. 14 with the circled numbers, the IPPV purchasing process starts with step 1 at STT with the IPG Application sending a purchase request to the application programming interface (API). The viewer interactions captured via the IPG PPV user interface and the IPG application is passed through the API to the Native Application via API calls.

20 The Impulse PPV request messages are stored locally at the STT until they are transmitted to the digital access control (DAC) at the Service Center. The DAC periodically collects purchase order data, collects the purchase requests through the out-of-band path comprising paths 2 and 3.

After the purchase request reaches to the DAC, it is passed to the CMS for authorization via path 4. The CMS then authorizes (or declines) the request by sending a response to DAC.

If CMS authorizes, then DAC sends the authorization message (ecm) and encryption keys (emm) to the MSO Content Delivery System (IRT's) as step 5. The PPV content is then delivered to the STT as shown in step 6.

If CMS declines the purchase request, then DAC sends the decline response to STT through NC and OM in out-of-band equipment.

Note that Live Events such as Boxing Games, Music Concerts can be processed within the same context as IPPV by considering such events as PPV but shown only once.

FIG. 15 depicts a process within the system architecture 1300 that enables premium service subscriptions via a server-centric interactive user interface. In order to provide the subscription process, the IPG Session Manager and IPG/VOD Subscriber/Billing Interface components are involved in the processes, in addition to DAC, with the messaging sequence as shown in FIG. 15.

The process starts as IPG Application sends a subscription request to SM following the out-of-band paths 1 and 2 in FIG. 15. With this path, the viewer interactions/requests captured via the IPG Premium Services Subscription user interface is passed to SM.

SM then passes the subscription request, along with the STT information, to the MSO CMS via the Billing Interface through paths 3 and 4. As the Premium Services Content and the subscribers belong to the MSO, subscriber information is not required to be maintained within the IPG system. The CMS then authorizes (or declines) the request by sending a message to DAC.

If CMS authorizes the subscription, via checking subscriber information and limits, then DAC sends the authorization message (ecm) and encryption keys (emm) to the MSO Content Delivery System (IRT's) as step 5. The Premium Services content is then delivered to the STT as shown in step 6. If the authorization is handled by a satellite-based national conditional access center, then the path 5 is replaced by the MSO via a satellite delivery. Upon STT receiving the authorization, the STT force-tunes to the Premium Service channel.

Note that in order to provide security in subscription, a password table/update mechanism can be maintained by SM. In such a password protected system,

a viewer can subscribe to premium service by providing password information via the interactive user interface, which is then delivered to the SM along with the requested premium service information.

FIG. 16 depicts a process within the system architecture 1300 that enables impulse purchasing from advertisements via a server-centric interactive user interface. The impulse purchasing from Ads, where the viewer is not involved personally with a sales person, is another e-commerce type (e.g., TV-commerce) that may attract viewers in near future in broadband world similar to the Internet.

One model is to replace the telephone purchase ordering with the two-way IPG system in dedicated TV-commerce channels and non-commerce channels. A telephone number in a dedicated channel is constantly displayed, and in a non-dedicated channel, a telephone number is displayed during certain periods along with advertisements.

In any of these cases, by replacing the telephone ordering process with the automated ordering via IPG will save operator/operation costs for the product-selling company. Considering these savings, IPG provider and MSO can jointly bill the product-selling company per each transaction as (fixed) commission-based or for a percentage, which is then shared between MSO and IPG provider.

Currently, for impulse ordering from advertisements, the CMS-to-DAC-to-STT path does not have real-time message processing capability. The following sections discuss possible systems and user interfaces for commerce-dedicated and non-dedicated channels.

For such a functionality, the system shown in FIG. 16 can be utilized. The illustrated system assumes CMS having the complete product information being advertised in a dedicated channel (s) which is retrieved by the IPG generator non-realtime ahead of time of purchasing transaction via path 5 (Another data center instead of CMS can be reached via path 5 if CMS does not have complete product information).

The IPG generator produces IPG impulse buying user interface bitmaps, which are then sent to STT through paths 6, 2, and 1 as out-of-band data. Such bitmap data can be loaded to STT via out-of-band periodically before the product is advertised, at a different time than the other out-of-band data. Or, this data can be demandcast to STT as requested. While the later introduces slight delay, it might be preferred due to limited time usage of viewer ordering process and requiring less STT memory footprint.

The TV-commerce user interfaces can be designed in a few different ways. IPG user interface icon, e.g., might appear as a constant screen on a corner of a TV-commerce channel (e.g., where the 800 tel. no. appears), upon click on brings the product information, and consequently ordering pages. Or, the IPG user interface can appear on the TV-commerce screen on request by clicking TV-commerce button, or similar one, on remote control, when the viewer decides to buy a product. A TV-commerce icon in IPG user interface may be clicked to list the current dedicated commerce channels. Upon viewing of this interface, viewer may click on a desired commerce channel to tune to it.

After the IPG user interface appears as overlaid on a dedicated channel, as soon as the viewer hits the purchase icon, a set of new interfaces appears to receive password data, product confirmation,..., and information, all of which are forwarded to the SM through reverse path. The same IPG overlay can be made to disappear from the TV-commerce channel upon viewer request.

The IPG Application sends the purchase request information to SM via paths 7 and 2. Then the SM passes this information through Billing Interface to MSO CMS via paths 3 and 4. The CMS checks the purchase request, and if authorizes, sends a response to SM via paths 4 and 3. Then, SM sends an out-of-band acknowledgement message to STT through paths 2 and 1. There is no in-band stream in this example to be sent to STT (Assuming the TV-commerce is selling products/content to be shipped via outside resources than MSO's system)

If the content purchased from advertisement is a music file or some other content to be streamed by MSO, then MSO CMS uses in-band content delivery to STT in addition to the described processes above.

For such TV-commerce impulse transactions, password mechanism and customer credit card information may be needed.

In a non-dedicated channel, a telephone number is displayed during certain periods along with the advertisements. The main difference of this case from the dedicated channel is the coordination of tremendous number of product information that appears with advertising in various channels. If the product information is available at CMS or a third party system, then IPG system works the same way as described above for the Dedicated Channels: e.g., during or at the end of an advertising, a pop-up IPG screen is used to initiate the impulse buying process. This user interface may also be demandcast as out-of-band.

FIG. 17 depicts schematically a spotlight or channel information window 1704 overlaying a broadcast video display 1702 in accordance with an embodiment of the present invention. The spotlight window 1704 is depicted as overlaying part of the lower portion of the screen. However, the spotlight window 1704 may also be overlaid on  
5 different portions of the screen. Also, the spotlight window 1704 may be of a different size or shape than depicted.

Prior similar windows have been generated at a set-top terminal 106. The present invention generates such a window at a server in a cable head end 102 or other distribution center. Because the window 1704 is generated at a server in accordance with  
10 the present invention, rather than at a terminal, the terminal may be simplified and made less expensively.

In accordance with a preferred embodiment of the present invention, a bitmap for the spotlight window 1704 may be digitally encoded and transmitted from the server to the terminal 106 via an out-of-band channel. In a preferred embodiment, one  
15 such a bitmap may be broadcast continually for each broadcast video channel. Alternatively, the bitmaps may be demandcast (sent by the server in response to requests from the terminals), but such an embodiment may have substantial latencies (delays). A terminal 106 (separate from or built into a television) receives and decodes the bitmap, and then overlays the bitmap over the broadcast video 1702.

In accordance with an alternate embodiment of the present invention, a bitmap for the spotlight window 1704 may be sent via an in-band channel. For example, the bitmap may be digitally encoded and multiplexed into a transport stream using an interactive information distribution system 100 like the one described above in relation to  
20 FIG. 1. The transport stream is then transmitted via a distribution network 104 to the terminals 106. A terminal 106 capable of receiving the transport stream, retrieving the bitmap, and overlaying the bitmap over broadcast video 1702 is described above in relation to FIG. 2.

A particular button on a remote control may be used to cause the spotlight window 1704 to "pop-up" and overlay the broadcast video 1702. The terminal 106  
30 receives a signal indicating that the button on the remote has been pressed. If bitmaps for the spotlight window 1704 are broadcast continually, then the terminal 106 overlays the appropriate spotlight window 1704 over the broadcast video 1702. Alternatively, if demandcast is used to transmit the spotlight window 1704, then the terminal 106 relays that indication upstream to, for example, the head end system 102. The components

within the head end system 102 then send the appropriate encoded spotlight window 1704 to the terminal 106. The terminal 106 then overlays the window 1704 over the broadcast video 1702.

FIG. 18 depicts an example layout 1704a for the spotlight or channel information window in accordance with an embodiment of the present invention. Different layouts are also possible and generally may be within the scope of the present invention.

The example layout 1704a displays channel number (e.g., "8"), broadcast network name (e.g., "ESPN"), and service provider name (e.g., "Comcast"). This information is shown on the left portion of the example layout 1704a, but it may instead be placed at other locations in alternate layouts.

The example layout 1704a also displays a program's title (e.g., "Mavericks: The Movie"), rating (e.g., "PG"), time period (e.g., "8:00-10:00"), copyright or release year (e.g., "1998"), and brief description (e.g., "The California big wave ...."). This information is shown in the middle portion of the example layout 1704a, but it may instead be placed at other locations in alternate layouts.

In addition, the example layout 1704a displays various modes of operation for the spotlight window 1704. The modes shown include: an "All" or all channels mode, a "Fav" or favorites mode, a "M" or movies mode, a "K" or kids mode, and a "S" or sports mode. These modes are shown in the right portion of the example layout 1704a, but they may instead be placed at other locations in alternate layouts.

Finally, the example layout 1704a includes a close caption icon ("CC"), a secondary audio programming icon ("SAP"), and a stereo icon 1802. The stereo icon 1802 indicates that the program is broadcast in stereo, otherwise the stereo icon does not appear.

Buttons on a remote control may be used to navigate between the modes and among channels within the spotlight window. For example, right and left arrow buttons may be used to select between modes, while up and down arrow buttons may be used to navigate among channels.

In the "All" mode, all channels available to the terminal 106 are navigable from within the spotlight system. For example, a press of the up arrow button on the remote will bring up the channel information for the next higher available channel (e.g., from 8 to 9), and a press of the down arrow button will bring up the channel information for the next lower available channel (e.g., from 8 to 6, if 7 is unavailable). While the



contents of the spotlight window 1704 change, the background broadcast video 1702 remains the same during such navigation (unless or until an "OK" or "Enter" button is pressed, at which point the broadcast video 1702 may change to the channel shown in the spotlight window 1704).

5                   In the "Fav" mode, only channels marked as favorite channels are navigated within the spotlight window 1704. For example, in the Fav mode, a press of the up arrow will bring up the channel information for the next higher favorite channel. Designations of favorite channels may be accomplished by user selection via a portion of the interactive program guide.

10                   Similarly, in the M mode, only movie channels or channels broadcasting movies are navigated. In the K mode, only kids channels or channels broadcasting content appropriate for children are navigated. In the S mode, only sports channels or channels broadcasting sports-related content are navigated. Other modes for other categories of specialized content may also be implemented.

15                   Note that common graphics used by the spotlight window 1704 (such as the background for the window, the spotlight logo, and the various icons including All, Fav, M, K, S, CC, SAP, and the stereo icon) may be stored at the terminal 106. The bitmaps for the non-common information (such as program names, descriptions of programs, rating, time, channel number, and channel name) are rendered (encoded) at the  
20 server and sent to the terminal 106.

FIG. 19 depicts an illustration 1900 that includes common portions of the channel information window 1704a in accordance with an embodiment of the present invention. The Favorites pull-down at the bottom of the illustration 1900 is activated when the channel information window is in "Favorites" mode. Similarly, other pull-  
25 downs would be visible in other navigation modes.

The above-described technique for navigating among channels does not change the background broadcast video 1702 during navigation among channels within the spotlight window 1704. An alternate or additional technique to navigate among channels involves changing the background broadcast video 1702 to display the broadcast  
30 of the channel currently being shown and described in the spotlight window 1704. Changing the broadcast video display may be accomplished, for example, by changing which video packet stream is being decoded and presented. Advantageously, this provides real-time updating of the background broadcast video 1702 in synchronization with the navigation in the spotlight window 1704.

In one embodiment of this alternate or additional technique, a special button on a remote control may be used to navigate in loop fashion amongst a series of channels. For example, in a "Fav" mode, pressing the special button may switch to the next available higher "favorite" channel. When the highest number "favorite" channel is reached, then pressing the special button may switch to the first (lowest number) "favorite" channel. Similarly, the special button may be used to navigate in loop fashion for other navigation modes.

The interactive program guide (IPG) display shown in FIGS. 3A-3C, and variations of this display shown in FIGS. 4, 6A-6C, 8-10, and 12A-12B represent specific designs of the IPG screen. Various other IPG screens can also be designed and are within the scope of the invention. For example, different number of channels, different number of time slots, different objects, and different arrangements of the channels and objects can be provided in the IPG screen.

In accordance with an aspect of the invention, techniques are provided to allow for customization of the IPG (custom-IPG) by a user (i.e., a viewer). The custom-IPG allows each viewer to define and arrange the IPG display according to the viewer's preference, and is highly desirable in providing an enjoyable viewer experience. For example, a particular viewer may want to arrange movies, news, sports, shopping, educational, and other types of channel together. The viewer may further prefer to arrange these channels in a particular layout that the viewer finds pleasing. The selection of the channels and the arrangement of the layout allow the viewer to quickly scan the available programs in the channels normally viewed by the viewer, instead of having to flip through pages and pages of channels in the regular program guide that may be of no interest to the viewer. With the custom-IPG, search time for the desired programs can be reduced, the likelihood of not finding the desired programs among the clutter of programs and channels may be minimized, viewer satisfaction may be enhanced, and other benefits may also be realized.

In accordance with another aspect of the invention, techniques are provided to efficiently generate and deliver the custom-IPG to the viewer, and for the STT to process and display the custom-IPG. With certain embodiments of the invention, the viewer can elect to view either the custom-IPG or the regular IPG (both of which are generated at the head end in accordance with an aspect of the invention). With certain other embodiments, the viewer can simultaneously view the custom-IPG overlaid on a program video.

The ability to create, render, and deliver the custom-IPG in an efficient manner becomes more important as the number of available programs and channels continues to grow (e.g., to hundred of channels or more) due to, for example, data compression, increased system bandwidth, and other factors.

5           FIG. 20 is a simplified flow diagram of an embodiment of a process to provide a custom-IPG. Initially, the custom-IPG is created or modified by a viewer, at step 2012. Various mechanisms can be used to facilitate the creation and modification of the custom-IPG, as described below. Once the custom-IPG has been defined or updated, it is generated at the head end, at step 2014. Various data structures and encoding  
10       schemes can be used to efficiently generate the custom-IPG. In an embodiment, the custom-IPG is stored for the viewer at the head end. The generated custom-IPG is then delivered from the head end to the STT, at step 2016. Various mechanisms can be used to efficiently deliver the custom-IPG, again as described below. The custom-IPG can be delivered when requested by the viewer or on an independent channel. The STT then  
15       receives, processes, and displays the custom-IPG, at step 2018.

          FIG. 21 is a flow diagram of a specific embodiment of a process for creating or modifying a custom-IPG. In this embodiment, the viewer initially selects to display the regular IPG screen (e.g., IPG screen 300A in FIG. 3A), at step 2112. This can be achieved, for example, by pressing a "Menu" key on remote control unit 280. In  
20       response, the regular IPG screen is processed and displayed on a monitor, a television, or some other display device, at step 2114.

          The viewer then initiates the customization process to create or modify the custom-IPG, at step 2122. Various mechanisms to initiate the custom-IPG can be implemented and are within the scope of the invention. In one implementation, to create  
25       or modify a custom-IPG, the viewer highlights the "Favorites" object on the regular IPG screen. In another implementation, a "Customize" object or some other object can be provided on the regular IPG screen to allow for entry into the custom-IPG environment. In yet another implementation, a special button on remote control unit 280 can be used to initiate the custom-IPG process.

30           In an embodiment, after the custom-IPG process is initiated (e.g., by highlighting the "Favorites" or "Customize" object), a pop-up menu is provided to assist the viewer with the customization process, at step 2124. This pop-up menu can be a spotlight window generated and delivered, for example, in the manner described above in reference to FIGS. 17 and 18. The pop-up menu includes a set of objects that can be

manipulated (e.g., highlighted or selected) by the viewer to create and modify the custom-IPG.

At step 2126, the process waits for a selection from the viewer. The viewer can elect to perform any one of a number of allowed functions such as, for example: (1) select a desired channel for inclusion in the custom-IPG, (2) remove an undesired channel from the custom-IPG, (3) change the location of one or more channels in the custom-IPG, (4) arrange the channels in the custom-IPG, (5) arrange the layout of the custom-IPG screen, and others. Upon receipt of a viewer selection, a determination is made of the particular selection made by the viewer, at step 2128.

If the viewer's selection is to add a channel to the custom-IPG, the process waits for the viewer's selection of a particular channel or a set of channels to be included in the custom-IPG, at step 2132. The viewer can enter a channel selection, for example, by toggling a channel provided on the display (e.g., if the regular IPG is also displayed concurrent with the pop-up menu), by entering the desired channel (e.g., with the remote control unit), or by some other mechanism. The selected channel(s) are then included in the custom-IPG, at step 2134. The process then returns to step 2126 and waits for another viewer selection.

Back at step 2128, if the viewer's selection is to remove a channel from the custom-IPG, the process waits for the viewer's selection of a particular channel or a set of channels to be removed from the custom-IPG, at step 2142. Again, the viewer can enter a channel selection, for example, by toggling a channel provided on the screen, entering the channel with the remote control unit, or by some other mechanism. The selected channel(s) are then removed from the custom-IPG, at step 2144. The process then returns to step 2126 and waits for another viewer selection.

Back at step 2128, if the viewer's selection is to change the location of a channel in the custom-IPG, the process waits for the viewer's selection of a particular channel or a set of channels to be rearranged in the custom-IPG, at step 2152. Again, the viewer can enter a channel selection, for example, by highlighting a channel provided on the screen. The selected channel(s) can then be moved about the screen, for example, by using the left, right, up, and down arrows on the remote control unit. Other mechanisms can also be used to move the selected channels, such as specifying a particular coordinate for the selected channel(s). The selected channel(s) are then moved to the indicated location in the custom-IPG, at step 2154. The process then returns to step 2126 and waits for another viewer selection.

Back at step 2128, if the viewer's selection is to exit the custom-IPG menu, the process terminates.

Buttons on the remote control unit can be used to assist with the customization of the IPG. As these buttons are depressed, the STT can receive the  
5 selections and forward them to the head end. The head end then updates the pop-up menu and/or the custom-IPG screen and sends them back to the STT for decoding and display.

The custom-IPG screen can be updated as the viewer performs the customization. In one specific implementation, upon the initiation of each action by the viewer (e.g., the selection of a set of channels for inclusion or exclusion in the custom-  
10 IPG, the movement of a set of channels to a new location in the custom-IPG screen, and so on) a command is sent to the head end. In response to the received command, the head end re-renders the custom-IPG and sends the re-rendered custom-IPG back to the STT for display. In this manner, the viewer is able to view the results of the viewer's selection and can further modify as desired. This allows for an interactive customization session.

15 In an embodiment, the viewer's custom-IPG screen is formed as a subset of the regular IPG screen. Upon receiving the viewer selection, the head end generates the custom-IPG screen. This can be achieved, for example, by removing the non-selected channels from the regular IPG screen and forming a smaller IPG screen for the requesting viewer. In another embodiment, the custom-IPG is formed as a new screen having the  
20 contents (e.g., channels) selected by the viewer and arranged in a particular layout also selected by the viewer.

Other mechanisms can also be used to create and modify the custom-IPG. For example, instead of being provided with a pop-up menu, a "customization" region can be provided (in addition to the guide and image regions described above) to allow  
25 for creation and modification of the custom-IPG. The customization region can be easily implemented, for example, with a "Customize" object provided on the regular IPG screen. In this implementation, the customization region can be activated by selecting the Customize object.

Once the customization region is active, the keys in the remote control unit  
30 280 can be used to select (i.e., add) and de-select (i.e., remove) channels from the custom-IPG. Initially, the current custom-IPG is displayed, or the regular IPG screen is displayed if no custom-IPG has been created. The viewer can then simply scroll through the displayed IPG screen and add/remove channels by hitting, for example, the add/remove button on the remote control unit 280. To add a channel that has been previously

removed, the viewer can, for example, enter the desired channel number with the numeric keypad in the remote control unit and hit the add/remove button. Upon completion of the customization, the viewer can exit from the customization region, for example, by highlighting an "Exit Customization" object, which can be formed at the same location as the Customize object. Alternatively, the viewer can exit from the customization region via a special key (e.g., an "exit" key) on the remote control unit.

Thus, as can be seen from the above description, various mechanisms can be used to support the creation and modification of the custom-IPG. FIG. 21 and the above description depict two specific embodiments of the process for creating and modifying the custom-IPG. Others mechanisms can also be implemented and are within the scope of the invention.

Using the customization process described above, a viewer can also rearrange the program guide based on the viewer's preference. The modification of the custom-IPG can be performed dynamically, and in any desired order and subset. The custom-IPG allows the viewer to select a small subset of the (hundreds of) available channels and to organize the selected channels in a viewer friendly arrangement. The custom-IPG screens for a particular viewer can be rendered, composed, formatted, and stored at the head end in a profile for the viewer.

In accordance with an aspect of the invention, the custom-IPG is generated at the head end and provided to the STT. This reduces the complexity and costs of the STT. Moreover, implementation of the custom-IPG at the head end allows for support of new features as they become available, without having to replace the STT.

In an embodiment, the viewer's custom-IPG can be overlaid on the program being viewed at the time of the selection to view the custom-IPG. The generation of the new screens can be achieved at the head end, when requested, by overlaying the custom-IPG on the current program. The generated screens with the overlaid custom-IPG can then be sent to the STT for display.

Various data structures can be used to efficiently encode the video screens having the custom-IPG overlaid thereon. Each custom-IPG screen overlaid on a video sequence results in a corresponding (and different) output video sequence. Multiple output video sequences are generated for multiple custom-IPG screens. These output video sequences have a common video portion but different custom-IPG portions. The redundant common video portion can be removed from processing to simplify the

encoding process and to reduce the amount of data needed to represent the output video sequences.

5 The output video sequences with the overlaid custom-IPG screens can be represented with a matrix representation, as described in the aforementioned U.S. Patent Application Serial No. [Attorney Docket No. 19880-001510]. Each column of the matrix can represent a group of pictures (GOP) corresponding to the video sequence with a particular custom-IPG screen overlaid on it. Typically, only the video portion changes with time and the custom-IPG portion does not change over the period of interest (i.e., the GOP).

10 In one data structure, the first picture in each GOP is encoded as an I-picture. The remaining pictures in one of the GOPs are encoded as a sequence of P- and B-pictures, which is referred to as a "base PID". The encoded I-pictures and the base PID are sent to the STT. To view a particular custom-IPG screen, the I-picture for the output video sequence with that custom-IPG screen is decoded, and the base PID is also  
15 decoded. The video portion from the decoded based PID is combined with the custom-IPG portion from the decoded I-picture to generate the desired output video sequence.

In another data structure, the first picture in one of the GOPs is encoded as an I-picture and the first picture in each of the remaining GOPs is encoded as a difference picture. The remaining pictures in the GOP with the encoded I-picture are encoded as a  
20 sequence of P- and B-pictures, i.e., the base PID. The encoding of the first pictures as difference pictures further reduces the amount of data to be transmitted.

In yet another data structure, a minimum number of pictures required to construct the video sequence and the custom-IPG screens is encoded. For example, if 15 custom-IPG screens are generated (and transmitted using 15 GOPs) and if each GOP  
25 includes 15 pictures, only the diagonal elements in the matrix need to be encoded. Each encoded element would include one of the custom-IPG screens and one of the pictures in the video sequence. The selected custom-IPG screen can be generated at the STT by decoding and combining the pictures from the proper rows and columns of the matrix.

These various data structures for generating output video sequences having  
30 the custom-IPG screens overlaid thereon are described in further detail in the aforementioned U.S. Patent Application Serial No. [Attorney Docket No. 19880-001510].

The generated output video sequences can also be efficiently multiplexed into a transport stream. In one embodiment, referred to as a "ganging structure", each

output video sequence is sent via a respective PID. Three video PIDs (or a different number of video PIDs) can be combined with one audio PID and one data PID into a transport stream. As many transport streams are generated as needed to send the required number of output video sequences. The ganging structure and other efficient structures are described in detail in the aforementioned U.S. Patent Application Serial No. 09293,526.

Various delivery mechanisms can be used to deliver the custom-IPG to the STT such that increased bandwidth efficiency is obtained and viewer interaction is improved (i.e., decreased system response latency). Some of these delivery mechanisms are described below.

In a specific embodiment, the head end overlays the custom-IPG on the program being viewed at the time of the viewer request to view the custom-IPG. Since the rendered custom-IPG screens are stored at the head end, upon receiving the viewer request to view the custom-IPG, the head end can overlay these custom-IPG screens on any particular program and deliver the resultant video sequence to the STT. The viewer can subsequently remove the custom-IPG overlay at any time by various mechanisms such as, for example, the toggle off functionality in the STT remote control. In response to the toggle off command, the head end can remove the custom-IPG overlay and send the unmodified program to the STT.

In the above embodiment, the viewer can also define the overlay position by sending the desired overlay coordinates to the head end. The desired coordinates may be expressed using, for example, the numeric keys on the remote control unit, the arrow keys, some other buttons available on the remote control unit (e.g., the move left and move right buttons), or some other mechanisms. Upon receiving the viewer request, the head end re-composites the custom-IPG and the video sequence and provides the new video sequence to the STT.

In another embodiment, the custom-IPG is provided on a channel that is independent of the channels used to carry the regular programming and program guide. This embodiment is particularly advantageous when the custom-IPG offers functionality related to an interactive service such as, for example, home shopping network. In this embodiment, the custom-IPG can be delivered to the viewer on one or more PIDs in one or more transport streams. Via the dedicated channel(s) assigned to the custom-IPG, the viewer may be able to interact with the head end with less delays.



In yet another embodiment, the custom-IPG is multiplexed and sent in the same channel used to provide the regular IPG. This embodiment conserves bandwidth while allowing the viewer to view the desired IPG. In this embodiment, the viewer can toggle between the custom-IPG and the regular IPG (i.e., via a toggle button on the remote control unit). In response, the head end delivers the viewer selected (custom or regular) IPG to the STT for decoding and display.

One or more video decoders can be used at the STT to decode the video sequences having the custom-IPG screens overlaid thereon. To reduce the processing delays, multiple decoders can be used to decode the selected custom-IPG screen. The decoders may also be directed to decode custom-IPG screen(s) anticipated to be viewed by the viewer, thereby reducing the delays if and when the viewer does select such screen(s). Multiple decoders can thus be used to increase the parallel processing and efficiency of the receiving STT.

FIG. 22 depicts a design of an interactive program guide (IPG) page 2200 that supports a search of a program guide database in accordance with an embodiment of the invention. IPG page 2200 can be used to implement a user interface for an interactive search, as described below. In the specific embodiment shown in FIG. 22, IPG page 2200 includes a time slot region 2205, a guide region 2202, an icon region 2240, a video region 2220, a logo region 2215, and a program description region 2250. The guide region 2202 includes a number of channel objects 2210a through 2210h used to display channel information for a guide listing of channels. These regions and objects are similar to those described above for the IPG pages shown in FIGS. 3, 4, and 6. Other designs for the IPG page with different layouts, configurations, and combinations of regions and objects can be contemplated and are within the scope of the invention.

In an embodiment, in the icon region 2240 of the IPG page, a search window object 2212 is provided to facilitate the searching of programming. The search window object 2212 can be designed to be any particular size and shape, and can further be located anywhere on the IPG page.

FIGS. 23A and 23B are diagrams that graphically illustrate the basic functionality of the search window object 2212 in accordance with an embodiment of the invention. Initially, the viewer moves through the IPG page 2200 and highlights the search window object 2212 (e.g., by moving the cursor over the search window object) or selects the search window object by other means. Once highlighted or selected, the viewer can enter one or more criteria (e.g., keywords) to be searched. Various techniques

can be used to enter keywords. In order to enter characters, suitable means, such as a remote control unit with a character set or an alpha-numerical keypad similar to the one on telephones, are provided to the viewer to enter text in the search box. In the example shown in FIG. 23A, the viewer enters the keyword "CNN." In response, the program guide database is searched (e.g., at the head end, as described below) and one or more search results are provided. In one embodiment, the IPG page that includes the (e.g., most relevant) search result is retrieved and displayed. For the simple example shown in FIG. 23A, the search result is (coincidentally, for this example) located on the same IPG page from which the search was initiated, and no IPG page needs to be retrieved. In an embodiment, the cursor is moved to the channel object on the IPG page corresponding to the search result, which in this example is CNN channel 5.

FIG. 23B is a diagram that graphically illustrates another search. In this example, the viewer enters the keyword "NBA." In response, the program guide database is searched and one or more search results are provided. Again, for the simple example shown in FIG. 23B, the search result is (coincidentally) located on the same IPG page from which the search was initiated, and no IPG page needs to be retrieved. The cursor is moved to the channel object on the IPG page corresponding to the search result, which in this example is ESPN channel 8.

Zero or more search results may be provided for any particular set of one or more keywords, depending on the number of matches between the keyword(s) and the contents of the program guide database. For example, it is possible that a number of channels may be showing the same or different NBA games or some other NBA related shows. In one embodiment, if multiple search results are returned from a search, the viewer can scroll through the search results (one by one) to select the desired result. The Up/Down entry in the cursor can be used to move to the next search result. Alternatively, the Increment, Decrement, Move Right, and Move Left keys on the remote control unit can be used to move back and forth between search results. If the search results are located in different IPG pages, the IPG page that includes the proper search result is retrieved and displayed.

From FIGS. 23A and 23B, it can be seen that different fields of the program guide can be searched. For the example shown in FIG. 23A, the viewer enters the name of the channel (e.g., CNN) to be searched. And for the example shown in FIG. 23B, the viewer enters a particular topic to be searched. The searching can thus be performed on various fields associated with the program guide such as, for example, the

channel number, the channel name, the title of the program, the short description associated with the program (e.g., as shown in the program description region 2250), some other fields, or a combination thereof.

FIG. 24 is a diagram of a matrix 2400 representative of a program guide database. The matrix 2400 includes a number of program guide entries for a number of (N) channels for a particular window of time that is divided into a number of (M) time intervals. Each column includes the program guide entries for N channels for one time interval, which in the example shown in FIG. 24 is 1 hour. If, for example, 200 channels are available and the matrix 2400 includes two weeks of programming, the total number of entries in the matrix would be  $M \cdot N = 67,200$  entries (i.e.,  $M \cdot N = (14 \times 24) \cdot 200 = 67,200$ ). Each entry in the matrix 2400 can include up to two half-hour program entries. As can be seen, the number of programs to search via manual means (e.g., scrolling through the program guide) can be overwhelming.

FIG. 25 is a diagram that illustrates the search results for a particular set of one or more keywords. In this example, four "relevant" search results (or choices) are found within the two-week program guide matrix in performing the keyword search. The choices can be ordered via one of numerous ordering schemes. In one ordering scheme, the choices are ordered based on their scheduled show times (i.e., presentation times and dates). In this scheme, the choice having a scheduled show time closest to the present time is provided first, and the choice having a scheduled show time furthest from the present time is provided last. In another ordering scheme, the choices are ordered based on their relevance to the keyword, which can be determined using a particular weighting scheme. For example, a match in the channel name may be given more weight than an exact match in a portion of the program title, which is given more weight than a match in a portion of the program description, and so on.

In the example shown in FIG. 25, each of the four choices is located within a different IPG page. The choices can then be provided to the viewer in various manners.

In one embodiment for providing the search results, the IPG page that includes the first choice can be retrieved and displayed (with the cursor being moved to the channel object corresponding to the first choice), similar to that shown in FIGS. 23A and 23B. The viewer can then scan the choices by simply moving the cursor up or down, by depressing the proper key(s) on the remote control unit or the STT, or via some other mechanism. The choices can be provided in a circular fashion such that choices 1, 2, 3,

and 4, and back to choice 1 are provided in response to consecutive commands to view the next choice.

FIG. 26 depicts a design of a search result IPG page 2600 used to present the search results, in accordance with another embodiment for providing the search results. In this embodiment, the search results are collected and provided in the search result IPG page 2600. After the search is conducted on the program guide database, the search results can be rendered in a separate search result IPG page by the head end and sent to the STT. In this embodiment, the viewer can view the search results in one search result IPG page (or more, if necessary) instead of jumping from one IPG page to another. The search results in the search result IPG page can be ordered according to different criteria as described above. As the viewer selects one of the search results, the related IPG page can be retrieved from the transport stream as broadcast or demandcast. Alternatively, as the viewer selects one of the search results, the STT can tune to the channel corresponding to the selected search result to retrieve and display the desired program. This embodiment has the advantage of providing the search results to the viewer in a more compact form via one (or more) search result IPG page.

FIG. 27 is a diagram that illustrates the selection of a particular search result in accordance with an embodiment of the invention. Depending on the particular implementation of the guide display and the search process, different functionality and results can be supported when the viewer activates a choice provided after the search. As shown in FIG. 27, the viewer initially enters a keyword on the search window and the choices from the search are provided, one at a time on different IPG pages (e.g., in response to the viewer's next command) or together on the search result IPG page. The viewer can scan through the choices until the desired choice (e.g., choice 4) is highlighted. As noted above, the cursor can be placed on the channel object corresponding to the highlighted choice. When the cursor is on the channel object corresponding to the desired search result, the viewer can select the desired choice by entering a particular key (e.g., the "Select" key, or some other key) on the remote control unit or the STT. In response, the STT can tune to the selected channel to retrieve and display the desired program.

The search window object on the IPG page can be activated in various manners, some of which are described below.

FIG. 28 is a diagram that illustrates one embodiment to activate the search window on the IPG page. In this embodiment, the path to reach the search window is via

the search window object 2212 located, for example, within the icon region 2240. To activate the search window, the cursor can be moved until it is over the search window object. For example, the cursor can be moved to the right (from the time objects in the time slot regions 2205), or to the bottom (from the filter icons in the icon region 2240), or to the top (from the video region 2220). The viewer can then enter the keyword for the search. The search window can be placed anywhere on the IPG page (e.g., in the logo region 2215, as shown in FIG. 28) without changing the user interaction model (e.g., the cursor movement).

In another embodiment to activate the search window, the search window can be reached directly via a "Search" button or a similar functional key, on the remote control unit or the STT. Upon depressing the Search key (e.g., by pressing on it once), the cursor can be moved to the search window, which is then activated. The viewer can then enter the keyword for the search. The search window can later be de-activated (e.g., by pressing on the Search key once more). Upon de-activation, the cursor can be returned to the position where it was before the search window was activated.

The search window object 2212 can be composed in various manners. In one embodiment, the search window object is composed as an icon in a manner similar to the other icons (e.g., the Pay Per View, Favorites, Movies, Kids, Sports, Music, Options, and Weather icons) shown in the icon region 2240. In another embodiment, the search window object is made a part of the video that is displayed in the video region 2220.

The search window object 2212 can be rendered in various manners. In one embodiment, the search window object (in the icon form or the video form) is encoded using a slice-based encoding scheme and the resultant video slices are sent to the STT via a particular PID. The STT can retrieve the PID for the search window object and arrange the slice start code such that the search window object is provided on the IPG page at the desired location. In another embodiment, the search window object is composed as a bitmap that is encoded and sent to the STT via an in-band channel or an out-of-band channel. The STT can receive, decode, and pre-load the bitmap for the search window object, which can later be displayed at the desired location.

Slice-based encoding is described in U.S. Patent Application Serial No. (Attorney Docket No. 19880-001510), entitled "EFFICIENT ENCODING ALGORITHMS FOR DELIVERY OF SERVER-CENTRIC IPG," filed June 21, 2000, and Serial No. 09/466,987, entitled "LATENCY REDUCTION IN PROVIDING IPG,"

filed December 10, 1999, both assigned to the assignee of the present invention, and incorporated herein by reference.

The search of the program guide database upon receiving the keyword entry can be achieved using various search schemes. In one search scheme, the search is performed by comparing the keyword(s) against the contents of the program guide database. The viewer can enter any combination of one or more keywords. Various search help features can be provided. For example, AND, OR, and other functions can be provided to allow the viewer to combine multiple keywords to generate more powerful search. Also, an efficient indexing system implemented at the head end, with pointers to the program guide entries, can be incorporated to improve the efficiency of the search process. After the completion of the search, the most relevant search results are identified and returned.

The search functionality described herein can be implemented by various system architectures. In one architecture, a server-centric system is used to support the search functionality. One such server-centric system is the DIVA<sup>TM</sup> System that supports delivery of interactive program guide, video-on-demand (VOD), portal services, and others. A design of a server-centric system is described in further detail below. The search process for a server-centric system is now described.

In the server-centric system, the program guide content is generated and composed at the head end (e.g., into a video form) and sent to the STT. The STT then decodes and displays the program guide on the IPG page.

Upon presenting a search window to a viewer, the STT can detect if a search has been activated. If a search has been activated, a search request message can be generated and sent to the head end. The search request message contains a set of parameters that may include, for example, one or more keywords entered by the viewer. Upon receiving the keyword(s), the head end conducts the search, identifies relevant matches, and sends the search results to the STT.

The search results can be provided in various manners. In one embodiment, if the search results include future programming that the current broadcast stream does not include, the IPG pages (or the PIDs of the IPG pages) that include the search results and the specific locations of the channels (i.e., the channel objects) within the IPG pages are sent from the head end to the STT. The search results can be encoded using a slice-based encoding scheme. Alternatively, if the search results are in the current broadcast stream, then only a pointer to the related IPG page may be sent to the STT. The

STT then retrieves the related IPG page from the transport stream. Such pointer to the related IPG page can be sent, for example, as part of private data stream.

The search results can be sent from the head end to the STT in various manners. In one embodiment, the search results are sent as data packets that are addressed to the particular viewer who initiated the search. The search result can be sent to the STT out-of-band via a separate stream or as part of a "spotlight" out-of-band data stream. Alternatively, the search result can be sent to the STT in-band as part of private data in a video stream. In another embodiment, the search results are sent in a separate stream (e.g., identified by its own PID) along with other scene descriptive information. The search results can be sent within the same transport stream as the video slices for the video region.

The search features described herein (especially the server-centric architecture) can be advantageously used to provide viewers with the means to easily and quickly find the desired (e.g., video and music) programs from among an overwhelming number of available programs. With the search features of the invention, the viewers can quickly locate the desired programs without having to remember their broadcast channels or the program names. These features become more important as the number of channels and the look-ahead programming period (inevitably) increase.

The search features of the invention are especially well suited for interactive program guides, which are commonly used for television and broadcast distribution systems. However, the search features described herein can also be advantageously used for other guide applications such as, for example, dining guide, local shopping, news, and others.

FIG. 29 is a block diagram of an information distribution system 2900 that can be used to provide an interactive program guide and to implement the search functionality of the invention. The system 2900 includes a head end 2902, local neighborhood equipment (LNE) 2908, a distribution network 2904 (e.g., a hybrid fiber-coax network), and a number of set top terminals (STTs) 2906.

Information distribution system 2900 is described in U.S. Patent Application Serial No. 08/984,710, filed December 3, 1997; Serial No. (**Attorney Docket No. 19880-002300**), entitled "SERVICE PROVIDER SIDE IPG ENCODER," filed November 1, 1999; Serial No. (**Attorney Docket No. 19880-001630**), entitled "MESSAGING PROTOCOL FOR DEMAND-CAST SYSTEM AND BANDWIDTH MANAGEMENT," filed March 30, 2000; and Serial No. (**Attorney Docket No. 19880-**

001210), entitled "SYSTEM AND METHOD FOR DELIVERY OF SHORT-TIME DURATION VIDEO SEGMENTS," filed June 27, 2000. These patent applications are assigned to the assignee of the present invention and incorporated herein by reference. One specific implementation of the system 2900 is known as the DIVA™ System  
5 provided by DIVA Systems Corporation.

The head end 2902 produces a number of digital streams that contain encoded information in (e.g., MPEG-2) compressed format. These streams are then modulated using a modulation technique that is compatible with a communications channel 2962 that couples the head end 2902 to one or more LNEs 2908 (only one LNE  
10 2908 is shown in FIG. 29 for simplicity). The LNE 2908 is typically located away from the head end 2902. The LNE 2908 selects data for subscribers in the LNE's neighborhood and re-modulates the selected data in a format that is compatible with the distribution network 2904. Although the system 2900 is depicted as having the head end 2902 and LNE 2908 as separate components, those skilled in the art can realize that the  
15 functions of the LNE may be incorporated into the head end 2902. Also, the elements of the system 2900 can be physically located anywhere, and need not be near each other.

In system 2900, the program streams are addressed to particular STT locations that requested the information through an interactive menu. An interactive menu structure for requesting video-on-demand is disclosed in commonly assigned U.S.  
20 Patent Application Serial No. 08/984,427, filed December 3, 1997. Another example of the interactive menu for requesting multimedia services is the interactive program guide (IPG) disclosed in commonly assigned U.S. Patent Application Serial No. 60/093,891, filed in July 23, 1998.

To assist a subscriber (a viewer) in selecting programming, the head end  
25 2902 produces information that can be assembled to create an IPG page such as that shown in FIGS. 3A through 3C. The head end 2902 produces the components of the IPG page as bitstreams that are compressed prior to transmission.

Within the head end 2902, a video source 2912 supplies a video sequence for the video portion of the IPG page, an audio source 2914 supplies audio signals  
30 associated with the video sequence, and a guide data source 2916 provides program guide data for the guide portion of the IPG page. The guide data is typically in a database format, where each entry describes a particular program by its title, presentation time, presentation date, descriptive information, channel, and program source. The video sequence, audio signals, and program guide data are provided to an encoding unit 2918.



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The encoding unit 2918 (which is described in further detail below) compresses the received video sequence into one or more elementary streams, the audio signals into one or more elementary streams, and the graphics produced from the guide data into one or more elementary streams. The elementary streams can be produced using  
5 a picture-based encoding technique, a slice-based encoding technique, or a combination thereof. The elementary streams are then provided to the cable modem 2950.

Within the cable modem 2950, the elementary streams are assembled into a transport stream that is then modulated using a modulation format that is compatible with the communication channel 2962. For example, the communication channel 2962  
10 may be a fiber optic channel that carries high-speed data from the head end 2902 to a number of LNE 2908. The LNE 2908 selects the IPG page components that are applicable to its neighborhood and re-modulates the selected data into a format that is compatible with the distribution network 2904. A detailed description of the LNE 2908 is described in the aforementioned U.S. Patent Application Serial No. 09/583,388.

15 The STT 2906 receives and demodulates the signals provided by the distribution network 2904 and decodes the demodulated signals to retrieve the IPG pages from the stream. The design of the STT 2906 is described in further detail below.

As shown in FIG. 29, the encoding unit 2918 includes a video processor 2920, a graphics processor 2940, and a controller 2930. The video processor 2920 further  
20 includes a compositor unit 2922 and an encoder unit 2924. The compositor unit 2922 combines the video sequence from the video source 2912 with advertising video, advertiser or service provider logos, still graphics, animation, other video information, or a combination thereof. The video sequence from the compositor unit 2922 is then provided to the encoder unit 2924.

25 The encoder unit 2924 includes one or more video encoders 2926 (e.g., realtime MPEG-2 encoders) and one or more audio encoders 2928 (e.g., AC-3 encoders). The video encoder 2926 receives the video sequence from the compositor unit 2922 and forms a (slice-based) bitstream (e.g., an MPEG-2 compliant bit stream) for the video portion of an IPG page. In an embodiment, the video encoder 2926 "pads" the graphics  
30 portion (illustratively the left half portion of the IPG page corresponding to the guide listing) with null data. The null data may be replaced by the graphics grid slices (e.g., at a later step, within the LNE). In this embodiment, the video encoder 2926 is designed for, and efficiently processes only motion video information, excluding the graphics data. The audio encoder 2928 receives the audio signals and forms a bitstream for the audio

portion of the IPG page. The encoder unit 2924 produces one or more elementary streams containing picture-based or slice-based encoded video and audio information.

5 The controller 2930 manages the (e.g., slice-based) encoding process such that the video encoding process is temporally and spatially synchronized with the grid encoding process. For slice-based encoding, this is achieved by defining the slice start and stop locations according to the objects in the IPG page layout and managing the encoding process as defined by the slices.

10 In an embodiment, the graphics portion of the IPG page is separately encoded by the graphics processor 2940. The graphics processor 2940 receives the guide data from the guide data source 2916 in FIG. 29. A guide data grid generator 2942 within the graphics processor 2940 formats the guide data into a "grid", e.g., having a vertical axis of program sources and a horizontal axis of time increments. One specific embodiment of the guide grid is described above with respect to FIGS. 3A-3C and 4.

15 The guide grid is a video frame that is encoded using a guide encoder 2944 designed for video with text and graphics content. The guide encoder 2944, which can be implemented in software, encodes the guide data grid (e.g., via a slice-based encoding technique) to produce one or more bitstreams that collectively represent the entire guide data grid. The guide encoder 2944 is designed to effectively encode the graphics and text content.

20 For slice-based encoding, the controller 2930 defines the start and stop macroblock locations for each slice. The result is a GOP structure having intra-coded pictures containing I-picture slices and predicted pictures containing B and P-picture slices. The I-pictures slices are separated from the predicted picture slices. Each encoded slice is separately stored in a slice-form grid page database 2946. The individual slices  
25 can be addressed and recalled from the database 2946 as required for transmission. The controller 2930 controls the slice-based encoding process and further manages the database 2946.

30 For a server-centric system, since the program guide database resides at the head end in, a two-way communication system via a back-channel 2964, from the STT 2906 through the distribution system 2904 to the head end 2902, is utilized to support the search features described above. The back-channel 2964 can be used to sent search requests and search criteria (e.g., keywords) from the STT 2906 to the head end 2902.

FIG. 30 depicts a block diagram of a set top terminal (STT) 2906 suitable for producing an IPG page and supporting the search functionality of the present invention. The STT 2906 includes a tuner 3012, a demodulator 3014, a transport demultiplexer 3018, an audio decoder 3020, a video decoder 3030, an on-screen display (OSD) processor 3032, a video compositor 3034, a frame store memory 3036, a controller 3050, and a modulator 3070. User interaction is provided via a remote control unit 3080. Tuner 3012 receives, e.g., a radio frequency (RF) signal comprising, for example, a number of quadrature amplitude modulated (QAM) information signals from a downstream (forward) channel. Tuner 3012, in response to a control signal TUNE, tunes to and processes a particular QAM information signal to produce an intermediate frequency (IF) information signal. Demodulator 3014 receives and demodulates the IF information signal to produce an information stream, illustratively an MPEG transport stream. The MPEG transport stream is provided to a transport stream demultiplexer 3018.

Transport stream demultiplexer 3018, in response to a control signal TD produced by controller 3050, demultiplexes (i.e., extracts) an audio information stream A and a video information stream V. The audio information stream A is provided to audio decoder 3020, which decodes the audio information stream and provides a decoded audio information stream to an audio processor (not shown) for subsequent presentation. The video stream V is provided to the video decoder 3030, which decodes the compressed video stream V to produce an uncompressed video stream VD that is provided to the video compositor 3034. The OSD processor 3032, in response to a control signal OSD produced by controller 3050, produces a graphical overlay signal VOSD that is provided to the video compositor 3034. During transitions between streams representing the user interfaces, the buffers in the decoder are not reset. As such, the user interfaces seamlessly transition from one screen to another.

The video compositor 3034 merges the graphical overlay signal VOSD and the uncompressed video stream VD to produce a modified video stream (i.e., the underlying video images with the graphical overlay) that is provided to the frame store unit 3036. The frame store unit 3036 stores the modified video stream on a frame-by-frame basis according to the frame rate of the video stream. Frame store unit 3036 provides the stored video frames to a video processor (not shown) for subsequent processing and presentation on a display device.

Controller 3050 includes an input/output module 3052, a microprocessor 3054, support circuitry 3056, an infrared (IR) receiver 3058, and a memory 3060. The input/output module 3052 forms an interface between the controller 3050 and the tuner 3012, the transport demultiplexer 3018, the OSD processor 3032, the back-channel modulator 3070, and the remote control unit 3080. The microprocessor 3054 cooperates with support circuitry 3056 such as power supplies, clock circuits, cache memory, and the like as well as circuits that assist in executing the software routines that are stored in memory 3060.

Although the controller 3050 is depicted as a general-purpose processor that is programmed to perform specific interactive program guide control function in accordance with the present invention, the controller can be implemented in hardware as an application specific integrated circuit (ASIC). As such, the process steps described herein are intended to be broadly interpreted as being equivalently performed by software, hardware, or a combination thereof.

In the embodiment shown in FIG. 30, the remote control unit 3080 includes an 8-position joystick, a numeric pad, a "Select" key, a "Freeze" key and a "Return" key. User manipulations of the joystick or keys of the remote control device are transmitted to the controller 3050 via an infrared (IR) link or an RF link. The controller 3050 is responsive to such user manipulations, executes related user interaction routines 3062, and uses particular overlays that are available in an overlay storage 3066.

After the signal is tuned and demodulated, the video streams are recombined via a stream processing routine 3068 to form the video sequences that were originally compressed. The processing routine 3068 employs a variety of methods to recombine slice-based streams, including using PID filter 3016 and demultiplexer 3018, as described in the aforementioned U.S. Patent Application Serial No. 09/583,388. Note that the PID filter implemented illustratively as part of the demodulator 3014 is utilized to filter the undesired PIDs and retrieve the desired PIDs from the transport stream. The packets to be extracted and decoded to form a particular IPG page are identified by a PID mapping table (PMT) 3064. After the stream processing routine 3068 has processed the streams into the correct order (assuming the correct order was not produced in the LNE), the slices are sent to the (MPEG) video decoder 3030 to generate the original uncompressed IPG pages.

The PID filter 3016 can be programmed to pass the desired PIDs and filter out the undesired PIDs. The desired PIDs are identified by the controller 3050 after the

viewer selects an IPG page to review. The PID mapping table 3064 is accessed by the controller 3050 to identify which PIDs are associated with the desired IPG. If the PID filter 3016 is available in the receiver terminal, it is used to retrieve the PIDs containing slices for guide and video portions. The demultiplexer 3018 then extracts packets from these PIDs and provides the packets to the video decoder 3030, in the order in which they arrived. If the STT does not have the optional PID filter 3016, then the demultiplexer 3018 performs the PID filtering and extracting functions. Depending on the particular STT implementation, a corresponding method is used to recombine and decode slice-based streams. These various methods are described in further detail in the aforementioned U.S. Patent Application Serial No. 09/583,388.

The foregoing description of the preferred embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.